Alyeska Reports

Special: The First Three Years

Published by the Alyeska Pipeline Service Company, builder and operator of the trans Alaska oil pipeline, September 1980.

Sunset over the pipeline, Pump Station 4 and the Brooks Range.

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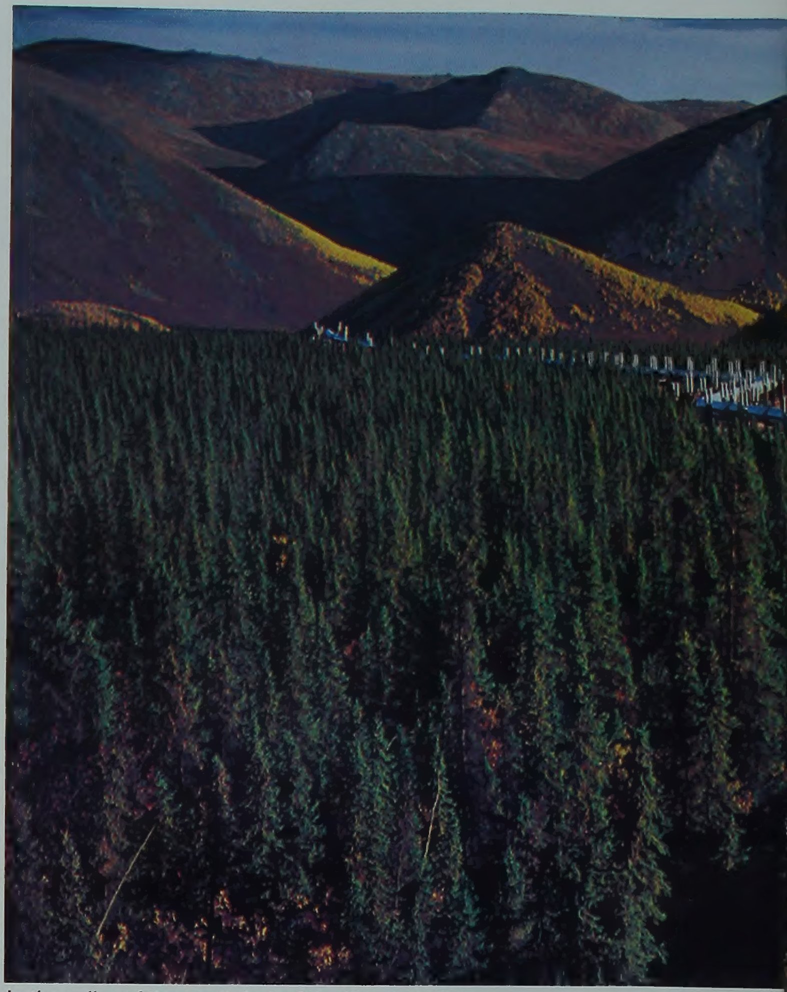
The Shakedown Years

BY E. F. RICE

The First Three Years: Alyeska Reports was published quarterly from January 1975, to October 1977, to inform the public about construction progress on the trans Alaska pipeline. In this special issue, the Alyeska Pipeline Service Company reports on the first three years of its operation. Material in this issue reviews the results of Alyeska's design, construction and operations planning; the effects of its environmental programs; and the economic impacts of its operation on Alaska and the nation.



In the valley of the south fork of the Koyukuk River.

One can usually assume that if oil is discovered, some way will be found to move it to market.

However, that may not always be the case.

If a discovered resource is too small, or if the cost of moving it is too high, or if methods of moving it to market cannot be developed economically, then the discovery may quite simply go undeveloped.

And that's what might have happened at Prudhoe Bay. Moving oil from northern Alaska posed a host of unique and extremely difficult problems. But the discovery was a huge one, more than 9 billion barrels of recoverable oil. And the engineers were able to develop solutions to all of the unusual problems.

Developers of the Prudhoe Bay oil field chose a pipeline as the best of all alternatives for moving the oil and formed a special company to locate, construct and operate it. But once the pipeline was chosen, a multitude of other problems remained, many of them never encountered before. Thus, the trans Alaska pipeline system became a pioneering project in many ways.

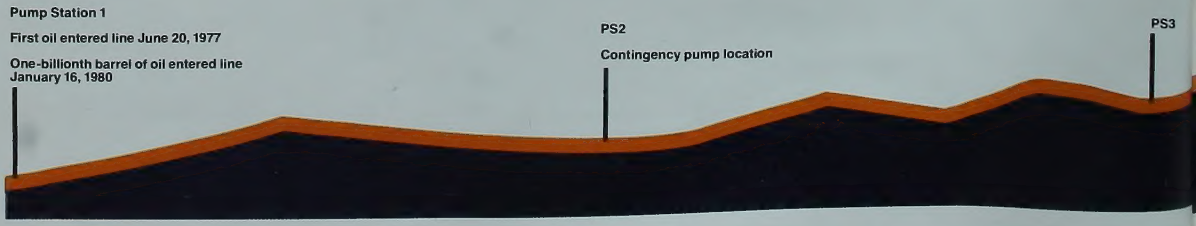
Earthquakes posed one of the more serious problems. A large part of the line and its terminal are located in some of the most active earthquake country in the world, and every part of the pipeline system had to be designed to withstand quake action. This was handled by making sure, first, that nothing important would break as a result of tremors as fierce as 8.5 on the Richter scale—a virtually unprecedented magnitude. And second, that the line could be shut down quickly during any earthquake large enough to threaten its safety.

The System

The trans Alaska pipeline was built to transport crude oil from proven reserves of 9.6 billion barrels of oil at Prudhoe Bay in northern Alaska to tankers at Port Valdez, 800 miles to the south. So far, more than one billion barrels have been shipped.

The oil, collected from the oil fields and pumped into the pipeline at Prudhoe Bay, flows through the line and a series of pump stations. The route crosses the North Slope, three mountain ranges, and some 800 rivers and streams before reaching the Terminal facility on Prince William Sound.

In the early stages of its operation, the pipeline carried about 750,000 barrels of oil a day to tankers at Valdez. Today, the line handles more than 1.5 million


Pump Station 1
First oil entered line June 20, 1977
One-billionth barrel of oil entered line January 16, 1980
PS2
Contingency pump location
PS3

Recd: Jan21/81
Order No.:
Price: Free
Acc. No.: Alyeska Pipeline Co.

STEVE McCUTCHEON

Corrosion can be a problem on any pipeline. But where a pipeline crosses an "auroral belt," and, as it does in Alaska, becomes the focus of earth currents caused by the same concentration of magnetic activity that causes the aurora borealis, corrosion control takes on a new importance.

There is yet no conclusive evidence to suggest that these earth currents damage the pipe. However, to protect against that possibility, the trans Alaska pipeline was not only coated, but, when buried, was totally wrapped in plastic tape and checked electronically to make certain the coating was complete.

Further, the below-ground sections were electrically connected to zinc ribbon anodes buried in the same trench. With this system, the sacrificial zinc is slowly consumed by any current flow instead of the pipe. The zinc anode also acts as a continuous ground path for any stray electrical current.

Isolation, climate and environment do not often create special problems for seekers for oil. Jungles, deserts, mountains, valleys—even sea bottoms—have caught their attention. Yet the distance, isolation, and severity of the Alaska climate made the problems of transporting crude oil from Prudhoe Bay unique. None of the several alternative methods was truly attractive. But the choice of a pipeline as opposed to, say, ice-breaking tanker ships, proved to be the best of the practical alternatives.

In other environments, perhaps, the pipeline would have been built as a turnkey project. Some large company would have contracted to design and build the line and then turned it over to an operating group, finished and ready to run.

But there were many things different about the Alaska project. First of all, the trans Alaska pipeline would not deliver oil to its final marketplace. Far from reaching its market, oil arriving at the south end of the pipeline would have to be transhipped by tankers to destinations elsewhere. The pipeline, therefore, would be only 800 miles of a total transportation route thousands of miles long—much of that on the sea.

In addition, the unusual line crossed Arctic tundra, three mountain ranges, many rivers, and three major geologic fault zones. For about half the pipeline's length, no surface transportation existed at all. A road had to be built along the route before construction could begin. And before route selection and preliminary design could start, topography and soil-boring data had to be collected. And also, before any construction could occur, a multitude of easements, permits, and purchases had to be processed.

Because almost all of the route was over federally or state owned lands, because of the national importance of the project, and because of the climate of public opinion emphasizing conservation, the U.S. Department of the Interior and the State of Alaska required agreement to certain stipulations before any permits were issued. Included were stipulations on the quality of materials and workmanship, on the preservation of the environment, and on plans for handling oil spills during and after construction. So stringent were the controls that even minor spills—a quart of lube oil spilled on a parking apron, for example—had to be reported and had to be contained, picked up, and disposed of, often by incineration of the contaminated gravel.

The stipulations also specified that certain sensitive areas—stream crossings, for instance—could not be disturbed when fish and wildlife might be affected. This meant that, in some areas, construction could take place only during the most difficult construction season. The stipulations meant constant surveillance by inspectors, each of whom could influence the work. This, too, was unprecedented.

STEVE McCUTCHEON

Drill bores hole for vertical support.

E. F. Rice, a civil engineer and ice scientist, was aboard the ice breaking tanker "Manhattan" when it made the first successful voyage through the Northwest Passage. He has written numerous articles on permafrost and Cold Region engineering and is currently a professor of civil engineering at The University of Alaska/Fairbanks.

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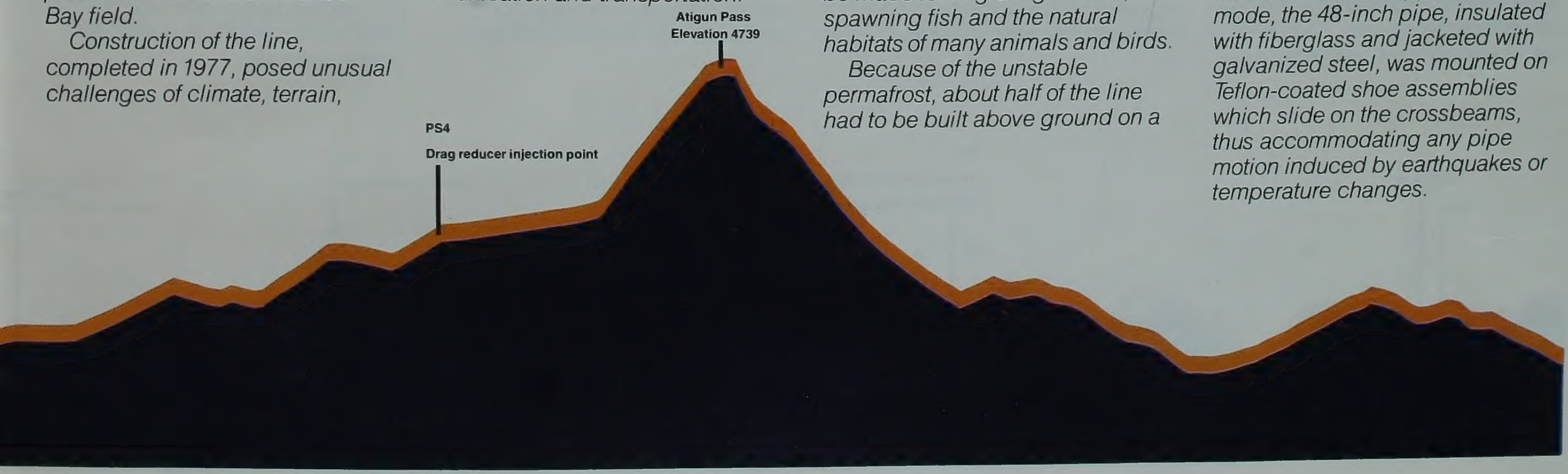
barrels—at a level matching the production rate of the Prudhoe Bay field.

Construction of the line, completed in 1977, posed unusual challenges of climate, terrain, unstable permafrost soils, communication and transportation.

Special allowances also had to be made for migrating wildlife, spawning fish and the natural habitats of many animals and birds.

Because of the unstable permafrost, about half of the line had to be built above ground on a system of crossbeams installed between vertical supports. In that mode, the 48-inch pipe, insulated with fiberglass and jacketed with galvanized steel, was mounted on Teflon-coated shoe assemblies which slide on the crossbeams, thus accommodating any pipe motion induced by earthquakes or temperature changes.



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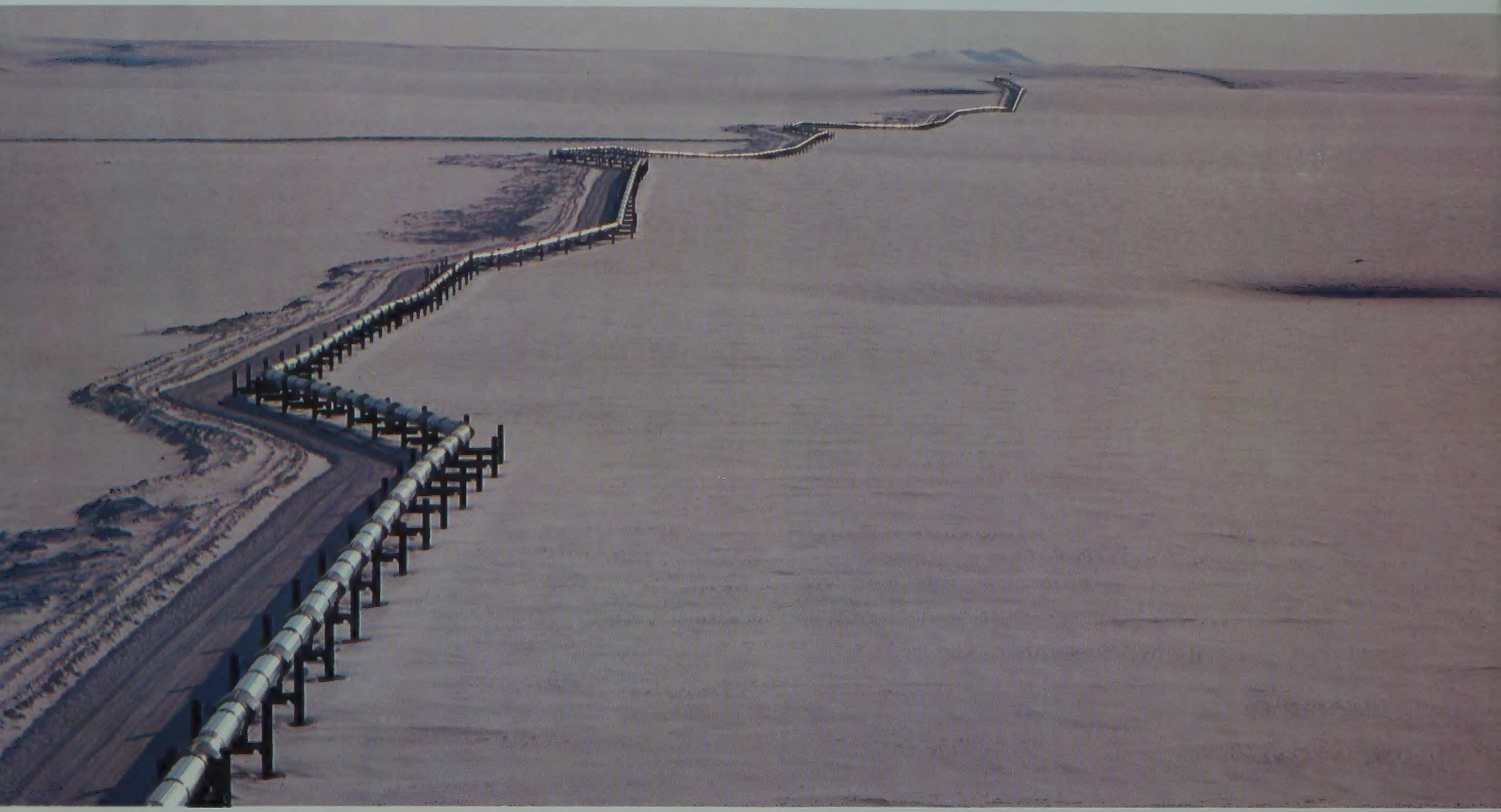

Zigzag configuration permits expansion, contraction of pipeline.

JIM C

Ice-rich permafrost proved to be one of the most dramatic, the most costly, and the most demanding features found along the pipeline route. Early-on, it was realized that a buried pipeline containing naturally warm oil from wells would heat the surrounding ground. It was realized, too, that cooling the oil would be impractical. Thus, the decision had to be made to elevate the pipeline, thereby preventing the oil's heat from melting the ice in the ground. However, this raised a host of new problems. Elevate it, how? On pilings? On sleepers? Bury it in an elevated gravel pad? Suspend it from poles?

Finding a solution to these problems took a lot of time and a lot of ingenuity. And there were still other questions. How could wide swings of temperature be handled? What would keep the supports from moving as the ground surface froze and thawed with the seasons? How would wild animals respond? These problems and many more required answers, and in some cases, tests of alternatives.

An elevated pipeline had to be erected wherever the soil along the route contained too much ice. For to melt such ground would be to manufacture mud, and mud would never provide a fitting support for such an expensive and important transportation mode.

As the data rolled in (it took three years and more) the designers determined that the line would have to be raised above ground for about half of its length. They found, too, that once above ground the pipeline would be subject to broad variations in temperature which would cause the pipe to expand and contract.

The empty pipe during construction, for example, could become as cold as the Arctic winter air—a minus 80 degrees Fahrenheit. But once the line reached full operation, the pipe would warm up in some places to about 145 degrees.

To accommodate such extremes, pipelines need either expansion joints (leaky and maintenance-prone) or else a configuration that allows them to bend without being overstressed. This last was chosen and applied in an ingenious manner. The pipe was given a trapezoidal configuration so that it could slide on crossbeams supported by vertical steel pipes (VSMs—vertical support members). This allows the pipe to contract without breaking in the cold, and to expand without buckling as it warms during operation.

The big remaining problem was to avoid either settling or raising of the VSMs through thawing or frost heaving. In the high Arctic, north of the Brooks Range, this was no great problem. The VSMs remain frozen tightly in place even during the short summer. Farther south, however,

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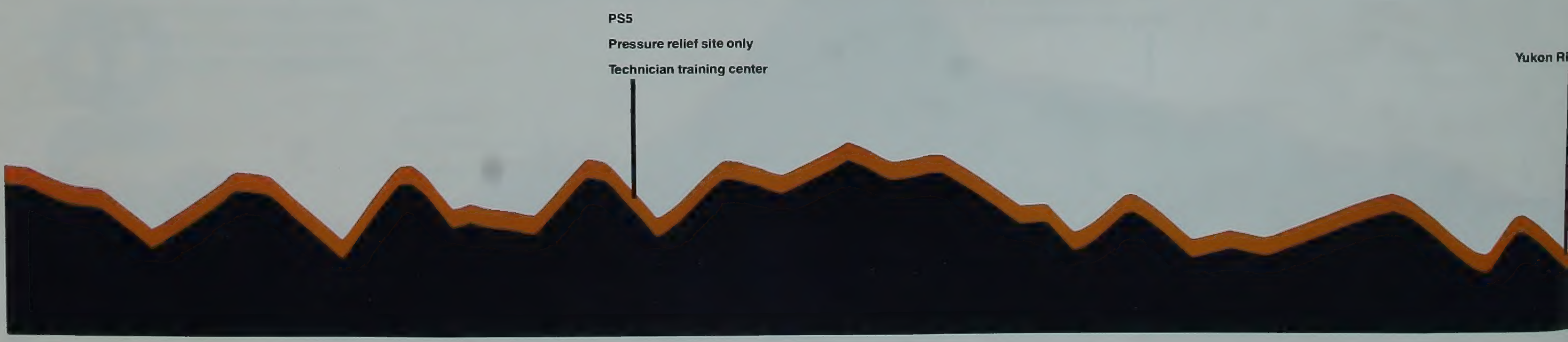
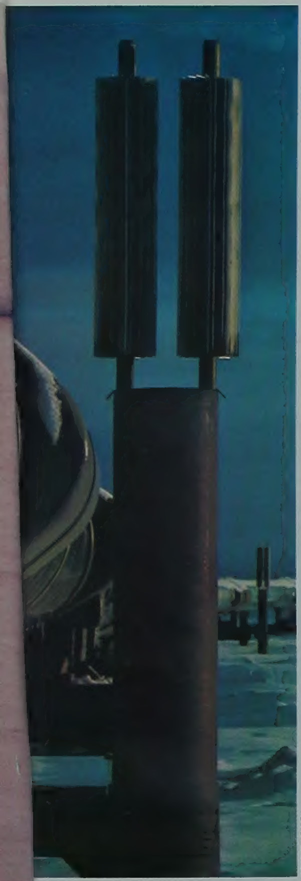
Where soil conditions permitted burial, the pipe was placed on a layer of bedding material in a ditch and then covered with gravel and dirt. In a few places, where the pipe had to be buried in unstable soil in order to provide a corridor for game migration, soil around the pipe is refrigerated to keep it stable.

Special devices, called pigs, equipped with blades and brushes are used regularly to clean accumulated wax from the interior of the pipe and to survey interior pipe diameters. The pigs are put into the pipe or removed at three pump stations and the Valdez Terminal.





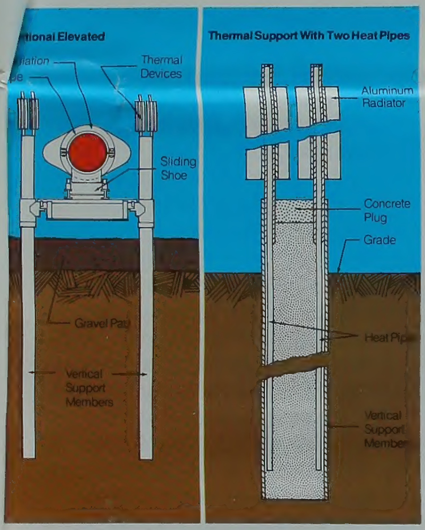
GEORGE HERBEN

JIM O

CCIA

e-ground support,
heat pipe.

Moose passes beneath supported section of pipeline.



VSMs are exposed to thawing in summer and to being lifted by frost action in winter.

Two solutions were advanced and both were used. First, the VSMs were anchored into the ground below thaw depths by forming ring-shaped bulges every foot or so along the supports. The holes into which the VSMs were placed were backfilled with a carefully specified slurry of sand and water, which, when frozen, interlocked with both the ringed pile and the frozen ground.

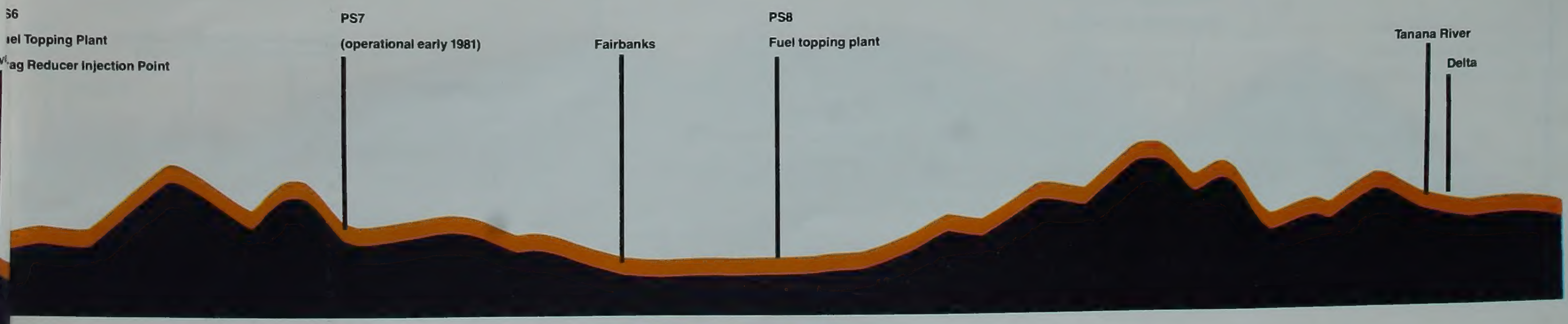
Second, the ground is kept frozen by using a thoroughly space-age technique. Inside these "thermal VSMs" are two hollow tubes, each containing a few pints of liquid ammonia and ammonia vapor, which fills the remaining space. The top ends of the tubes protrude "into the weather." When the temperature is low, the vapor condenses into liquid ammonia and runs down to the bottom of the tube. There it absorbs heat, turns to vapor again, rises to the top, and endlessly repeats the cycle, each time carrying heat from the warm ground to the cold air. To aid the process, the top of the heat pipe is fitted with some aluminum cooling fins, and the bottom is imbedded in the frozen slurry within the VSM. Action stops only when the weather is warmer than the ground. However, because the tubes remove so much heat in winter, the ground remains frozen all summer. In this way, most of the elevated pipe has been stabilized, using climate itself to aid in subjecting the permafrost.

Animal crossings demanded special considerations. An elevated pipe, designers knew, could conceivably appear like a fence to wandering animals. Caribou, particularly, during their seasonal migrations, might be reluctant to pass under the pipe.

Ten pump stations are now operating to move oil through the system.

Stations in permafrost areas were constructed on soils which are kept frozen by mechanical refrigeration units.

Turbine pumps, driven by hot gas from aircraft-type jet engines, move the oil. North of the Brooks Range, the engines are powered with natural gas from the Prudhoe Bay oil fields. South of the range, three topping plants produce a kerosene-like turbine fuel from pipeline oil for the pump station engines.



To meet this challenge, the pipeline in many places was raised high enough to allow passage to moose. In other places, however, the pipe was buried even though the ground was ice-rich. This, of course, required some careful engineering. The buried pipe was specially insulated and then refrigerated to keep the ground from thawing just so skittish caribou could cross the pipe without passing under it. There are about four miles of "special burial" where such refrigeration was required and some 26 other shorter non-refrigerated buried crossings. Experience indicates now that caribou cross under the elevated pipe without difficulty.

GEORGE HERBEN

Special bridges span rivers along the pipeline route.

Stream crossings also required special treatment, both in the design of the crossing and in the timing of construction (to avoid sensitive ecological periods). Typically, the pipe was buried under streambeds at a depth to avoid scour. Heavy concrete weights kept the empty pipe from floating, and the trench was then backfilled to restore original contours to the stream bottoms.

Larger streams were bridged by 180-foot clear-span plate girders. Five of these included two or more spans. Suspension bridges cross the Tazlina and the Tanana rivers, where there was need to keep the channel free of piers. They add an aesthetic dimension in some difficult areas. In my view, the most attractive bridge of all is the tied arch that carries the pipe across the beautiful Gulkana River. This bridge has its abutments frozen in place by the same kinds of heat tubes that are used to stabilize the VSMs.

Startup got underway June 20, 1977, when the first crude oil was pumped into the line at Prudhoe Bay. The oil, gathered, de-gassed, and de-watered was injected into the line behind a "pig" which pushed a cloud of combustion-preventing gaseous nitrogen ahead of it.

Three groups of "line walkers" accompanied the oil front. One walked at the front, checking progress of the oil by listening to the mechanical tapping of the pig as it moved along at about one mile per hour.

The second walker group came a day later, and a third party followed a day after that. Even after the passage of the front, ground parties continued their vigil for several weeks more. (The pipe is still being scrutinized periodically in order to detect troubles that might conceivably escape notice by the numerous monitoring instruments.)

Filling a cold pipeline with hot oil is not simple. Even though each section of the pipe had been pressure-tested with water to well above the design requirements, there was always a possibility of trouble.

As it turned out, there was trouble. First, a wheeled front-end loader accidentally bumped and broke a vent fitting, starting a leak which had to be repaired and cleaned up before filling could resume.

Later, at Pump Station 8, about 500 miles along the line, a pipe cracked as cold liquid nitrogen was being injected, because of an operator error, in front of the moving oil. Again, the flow was stopped to permit repair.

Still later, on July 8, as workers were replacing a strainer on a standby pump at the station, oil was accidentally diverted to the opening, spraying the inside of the building. Fire from ignited fumes killed one man and injured five others—a major tragedy.

After bypassing Pump Station 8, the oil continued down the line, reaching Valdez on July 31, ready for loading into tankers. The first of these, the ARCO Juneau, sailed on August 1 with oil from Prudhoe Bay, starting the long-delayed injection of Arctic energy into American markets.

The pipeline was designed to transport at least 1.2 million barrels of crude oil per day at first, and then, with the addition of several more pumping stations, about 2 million

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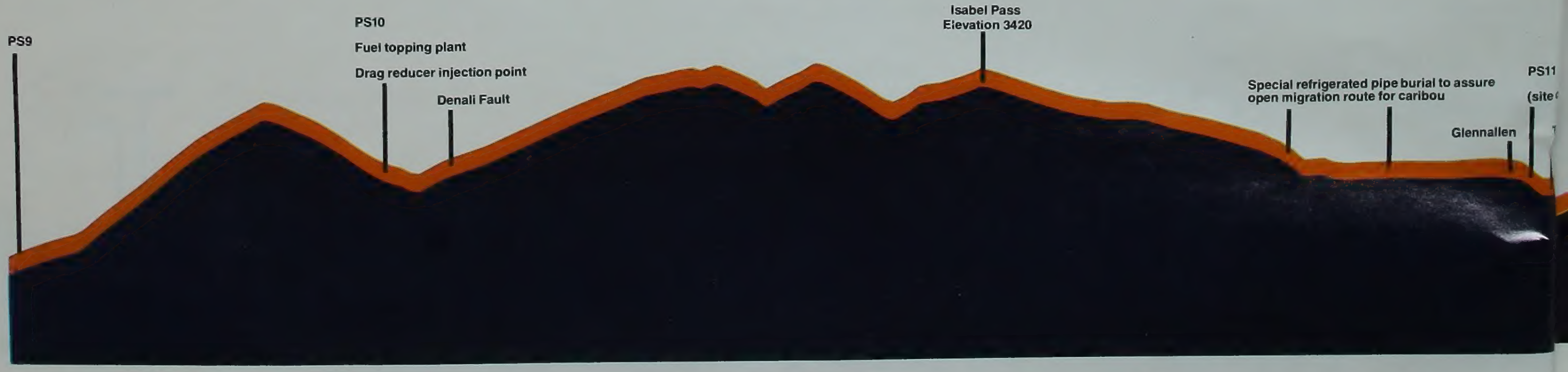
Terminal facilities include everything necessary for storing and loading oil aboard tankers. Storage facilities include 18 cone-roof tanks with a capacity of 9,180,000 barrels of oil. Using four berths, tankers of 16,000 to 265,000 deadweight tons can be loaded at rates up to 110,000 barrels an hour.

Other shore facilities include a vapor recovery plant, ballast water treatment system, operations control center and other support facilities.

The vapor recovery plant provides inert gas blanketing for oil storage tanks and also collects inert gas and oil vapors whenever they are vented from the tanks. All


PS9
PS10
Fuel topping plant
Drag reducer injection point
Denali Fault
Isabel Pass
Elevation 3420
Special refrigerated pipe burial to assure open migration route for caribou
PS11
(site
Glennallen

barrels per day. The oil field production rate is now about 1.52 million barrels per day. This requires more pumps than are currently installed, but fewer than the ultimate design. However, while some of the added pumps are being installed, chemistry has come to the rescue. By adding quantities of a special drag reducing additive (itself a petroleum product) the oil is being moved along at an increased rate with the present pumps.

Operation of the line has continued for three years and it is now appropriate to inquire how well the design worked out in actual practice.

What changes should have been made? What sort of defects have been revealed? Was the steel right? Did the welds hold? How about the elevated design? If it were all to be done over again, what should be done differently?

To start with, there have been no leaks or failures anywhere due to improper or defective materials. The start-up leaks were caused by human error and had no continuing effect.

Although some major future accident may yet cause regret because the pipe is so exposed, the elevated system has also operated superbly. Neither the elevated pipe nor its support structures has required a single change in design or construction.

Indeed, there have been only two purely operational leaks in the mainline pipe, and neither was in an elevated section. Both of these were caused by deformation of buried pipe when the supporting permafrost melted. One was on the summit of Atigun Pass where avalanche dangers had been considered too great to expose the pipeline above ground. This was repaired by special underground supports and installation of refrigeration tubes.

The other leak, at mile 734, was a case of burying a section in undetected ice-rich soil. It, too, deformed as the supporting permafrost melted. These two examples graphically reinforce the wisdom of elevating the line over ice-rich ground.

A third leak—caused by an act of sabotage—occurred in an elevated section. And, as noted earlier, a fourth leak took place during startup, as did two incidents at or near Pump Station 8.

That such an unprecedented facility could be operated with such a lack of trouble is remarkable, even astounding.

Perhaps at no other time in technological history has so great a leap "ahead of the art" been made with so little trouble. Neither the elevated pipe nor its support structures have required a single change in design or construction.

Arctic pipeline systems yet to come may not be designed in the exact image of the trans Alaska line, but many of the Alaska pipeline's features will certainly set precedents for the future.

DON DORNAN

Lights symbolize pipeline controls.

DON DORNAN
DON DORNAN

Crewmen maintain equipment.

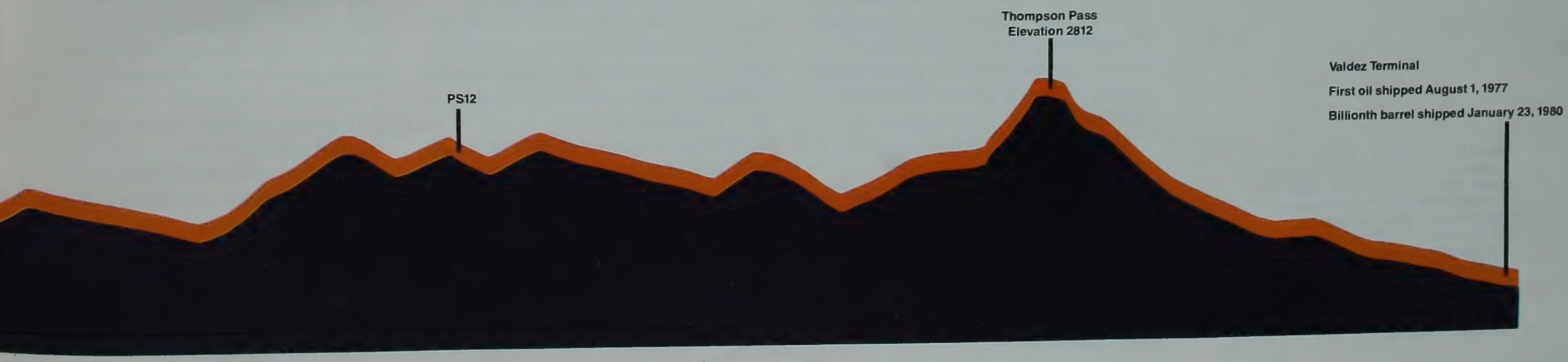
JIM COCCIA

Tanker is readied to take on crude oil at Valdez.

vented gasses are incinerated.

The ballast water treatment system processes ballast water discharged by tankers and all other oily waters collected in the Terminal. Cleansed water is discharged, after testing, into Port Valdez.

At the control center, pipeline and terminal controllers monitor and control every part of the pipeline system. The controllers, aided by computers, push-button control panels and data displays, can start and stop pumps, control valves, isolate pump stations, direct the flow of oil to tanks or tankers, start and stop parts or all of the system, and initiate a wide range of emergency procedures.



People Remain Key to Success Of Pipeline

by Vicky N. Sterling

Five years ago, Meredith Morton was a librarian. Marty Gronewald was operating and maintaining weld X-ray equipment on the trans Alaska pipeline, after moving from an eight-year DEW Line job. Bob Stirling had just graduated from high school in Anchorage.

Today, all three are among the approximately 520 field personnel employed by the Alyeska Pipeline Service Company who are involved in the complex process of delivering crude oil by pipeline from Prudhoe Bay to tankers at Port Valdez. An additional 570 people are involved in management and administrative duties for Alyeska.

Morton now is an instrument technician at the Valdez Terminal power generation and vapor recovery plants.

Gronewald, who started as a pump station operator, is maintaining, repairing and monitoring pump station equipment. And Stirling is a pump station operator involved in monitoring and control duties.

More significant, however, than the jobs the three hold is their involvement in efforts, encouraged by the company, to expand and develop their own personal skills.

The challenge of learning something new was one of the things that attracted Meredith Morton to her new job away from the library. She finds her instrumentation work "intellectually satisfying."

"It's like a handicraft," she explains, "plus you have to use your head. One day I may be clean and neat and the next day up to here in hydraulic fluid. Sometimes I may be using a miniature screwdriver and another a huge wrench."

She finds such variability more interesting than the confines of a library.

Gronewald, known on the job for trying to modify everything, spends many of his off-hours studying equipment circuitry behind service panels or programming personal calculating devices: "I've even got one that talks back to me."

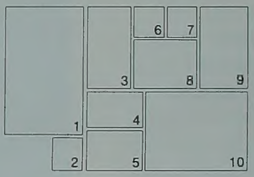
"It just bugs me if something doesn't work right," he explains. "Plus, I've got my hands full here trying to learn exactly how everything operates—hopefully before it breaks and I have to fix it."

Gronewald is completing work for degrees in petroleum technology and electronics in addition to teaching radiography and a course section on distillation and refining at Tanana Valley Community College.

Like the others, Stirling also is working toward a future goal. He's banking money so he can return to school and complete work on a degree in biology. He has plans for medical school.

Studying for advancement is encouraged by Alyeska. Under its Technician Progression Program, workers can advance through a series of grades to earn better job assignments and pay increases with each progression.

1. Pipeline at Pump Station 6
2. Stokeley Kindrell 3. Tools of a technician
4. Bob Miller 5. Miller, Meredith Morton
6. Bob Miller 7. Jamie Morrow
8. Miller, Morton 9. Marty Gronewald
10. Tankers at berth, Valdez Terminal



And helping each other through the advancement process is part of the program.

"There isn't a person here who doesn't want to help you learn," explained Wes Yamaoka, an operator technician who has worked at remote locations in Alaska's Brooks Range since 1974.

"I like to discuss the technical aspects of my job with others," Ms. Jamie Morrow, an operator technician, explained. "It's a good review."

Technicians throughout the company also cross-train on the job to learn new skills. Stokley Kindrell, for instance, is a certified physician's assistant who is learning a new field, instrumentation.

"You get to a point in life where you think you really know something and need to expand," he says. "Here on the pipeline I'm always working and learning with a higher level technician. It's a challenge."

Work schedules within the company encourage personal study both on and off the job.

Most pipeline workers work 12-hour shifts, seven days a week, in a week-on, week-off rotation. Some devote their weeks off to families or to recreational pursuits. Others hold a second job or run part-time businesses. Some become deeply involved in community activities. And still others continue their educations.

Working on the pipeline now is certainly not at all like it was during the construction period.

Five years ago, before Morton, Gronewald and Stirling had any idea they'd be working on the pipeline, more than 20,000 persons were busily engaged in what was then the biggest privately financed construction job ever.

Construction camps along the line housed the entire spectrum of crafts, trades, and workers of every ethnic and educational background. The air then was alive with the clatter of round-the-clock construction and the sounds of hard-working people.

Today, the sounds are much more subdued and the number of workers much, much smaller but no less

Vicky N. Sterling is a writer and editor who has covered Alaskan news and industry since 1973, working first for the Anchorage Daily Times, then on internal publications for Alyeska during the pipeline construction phase. Sterling currently is a technical writer for an Anchorage consulting firm, where she is involved primarily on environmental studies projects.

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GEORGE HERBEN

diverse than before. But the activities continue.

A steady hum from massive pumps, turbines and generators has replaced the roar of tractors and drilling equipment.

And today's workers, rather than running jackhammers, "Cats" and welding machines, are more quietly monitoring dials and maintaining equipment.

Even the recreation level is quieter now. Pump station ping-pong and pool tables attract casual exchanges today rather than the sleeves-up competition of the construction camps.

In today's living quarters and recreation areas, technicians involve themselves in the more sedate activities of reading, discussing technical and training problems, watching TV, lifting weights, taking photos, exercising, or practicing karate.

Workers at some pipeline sites are able to return home at the end of their shifts each day. However, many others in remote areas live on-site in special dormitory facilities during their week-on stints for the company.

The staff at each operating pump station includes a manager whose authority extends over crews of both daily 12-hour shifts; two chief supervisors, one for each week; and two maintenance supervisors, one for each week.

The number of operator technicians at a station can vary from eight to 20, and the number of maintenance technicians from four to 10, depending primarily upon the complexity of the station. Stations which have mainline pumps and on-site power generation, scraper pig receiving and launching facilities, a topping unit, or a drag-reduction additive facility require a larger basic crew.

At the Valdez Terminal, the 27 persons on the managerial staff work a regular 40-hour week, while the 150 technicians work 12-hour shifts on one-week rotations.

Operator technicians at the Terminal are assigned either to the power generation-vapor recovery oil movement and storage area, or the marine and ballast area.

A fire and safety specialist and a technician trained as a medic are assigned at every location. Another two dozen persons are responsible for the direction of maintenance or other work needed on the pipeline itself.

The personnel totals, however, do little to reflect the quality of actual system operations.

As one pump station manager, said: "We look at each other as people here, and, by doing so, have become a more efficient group."

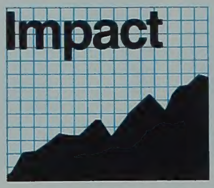
And Bob Miller, a terminal maintenance foreman and veteran of refinery and chemical installations, put it all in perspective: "My crew is comparable to any I've seen anywhere in 20 years."

Economic Impact Beyond Expectations

by William J. Tobin

If everything about the construction of the trans Alaska pipeline seemed incredible in its size and scope, what has happened in the three years since the project was completed is even more impressive. It is beyond anyone's predictions and almost beyond the boundaries of the mind's normal measuring rods.

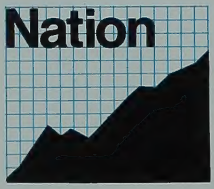
Impact



"The very first thing that strikes you about it all," says Russ Meekins Jr., chairman of the Finance committee of the Alaska House of Representatives, "is that 94 percent of all our state revenue is coming down that 48-inch pipe."

Not quite so dramatically perhaps, but still significantly, the 800-mile pipeline from Prudhoe Bay to Valdez has also had a powerful impact on the nation's energy status and on the country's economy.

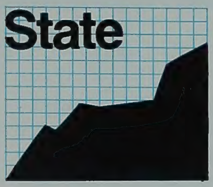
Nation



"As bad as the inflation rate is," says Republican Ted Stevens of Alaska, minority whip of the United States Senate, "it would be worse without Alaska's oil supply."

And as the pipeline grows increasingly more vital from a national standpoint, it becomes absolutely entwined in the social, political and economic fabric of Alaska. It touches the life of every Alaskan.

State



"I was one of many Alaskans who grubstaked themselves on the pipeline," says Representative Meekins. "I worked two seasons on the North Slope and the money I earned paid my way through graduate studies in economics at the University of Oregon." Now the 31-year-old Democratic legislator holds one of the most powerful positions in state government, with a direct view of what the pipeline means to Alaska.

"Without it," he says, "we wouldn't be able to pay for even the normal operations of the state. I know if that pipeline were shut down we'd be broke."

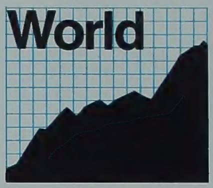
For Alaska's 400,000 residents, that would be a calamity. But for the nation, the impact might be even worse.

"Prudhoe Bay and the trans Alaska pipeline are making the single most significant contribution to the nation's energy production, far and away more than anything else," says Democratic U.S. Senator Mike Gravel of Alaska.

Senator Gravel played a special role in the pipeline project, introducing in 1973 the legislation that finally broke the legal logjam of opposition that had blocked the start of construction.

"I'm convinced that had that piece of legislation not passed," Gravel says today, "the pipeline would have run into the same quagmire of delay that has blocked Alaska land development through wilderness withdrawals. "Prudhoe Bay would have been locked up then and would be locked up now and the consequences would have been world-shaking."

World



"When you're talking about delays," says Senator Stevens, "don't overlook what would have happened had the pipeline been completed in 1972, as first planned. The first pipeline oil would have been delivered to U.S. markets before the 1973 Arab embargo, making the effects of that embargo less severe. The whole world economy changed because of the delays imposed by environmental opposition to construction of the line."

Prudhoe Bay and the pipeline help insulate the United States from further economic pressures by foreign producers. "The recent Iranian oil boycott," Senator Stevens adds, "caused some short-term inconveniences but no serious long-term disruption. This contrasts with the '73 Arab oil embargo which cut American oil supplies by 2 million barrels a day and provided the initial spiraling of prices by the OPEC cartel."

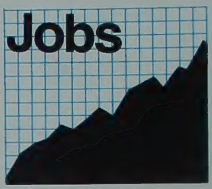
Such assessments—which look at the economics of the pipeline in 1980 terms—seem light years away from the hectic days of the mid-70s when construction activity was at its height. The project, in the glare of a national spotlight then, too often seemed to focus only on horror stories indicating Alaska was a no-man's land of crime, corruption, prostitution, big bucks, high prices and social upheaval.

Progress

"Sure, we had people who screamed and yelled and said we had nothing but drunks and trouble on our hands," says peppery 73-year-old Dr. William R. Wood, mayor of Fairbanks and former president of the University of Alaska. But he recalls the pipeline construction years as "a lovely time, packed with excitement I wouldn't have missed for the world." And what does it mean for Fairbanks now? The mayor says:

"We're much better off than we've ever been in our history, much better. We got a lot of new businesses. Not all of them succeeded, but most of them did. We got three new shopping centers. And a lot of new homes. And we'd have not one damn penny of it without the pipeline."

Jobs



Few cities in Alaska were so dramatically touched by construction of the pipeline as Valdez, terminus of the 800-mile energy lifeline and site of the $1 billion marine facility.

"The pipeline and the tanker terminal have opened the doors for Valdez," says the city's 28-year-old mayor, Bill Walker. "We've found we like industry, and thanks to Alyeska, we have the means to attract more." That now includes the projected billion dollar – plus refinery proposed for construction at Valdez by Alpetco, a joint venture of Charter Oil Co. and the E.F. Hutton Company. Alpetco has a 27-year contract from the state to purchase 75,000 barrels a day of Alaska's royalty oil to be delivered by the pipeline.

Walker welcomes the new jobs and the new people the Alyeska and Alpetco project will bring to Valdez. The town boasts a population of 4,500 now—down from more than 12,000 at the height of the construction years, but still four times larger than it was before the pipeline.

"We're much more of a blend now," the mayor says. "We've got a real mix of people, enriched by those who have come as a result of the pipeline. People from all parts of the world. Oilmen who have been everywhere. And Coast Guard people we never had before. This is just a much better place to live."

Native Development

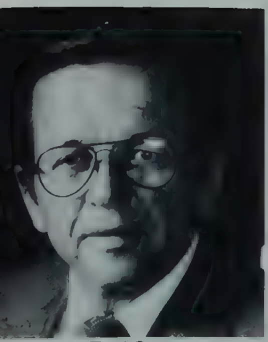
The impact on economic and social structures has probably been most strongly felt among the Native population.

Willie Hensley, chairman of United Bank Alaska and one of the state's most influential Native leaders, was a member of the Alaska House when the state received its first $900 million bonanza from North Slope oil leases.

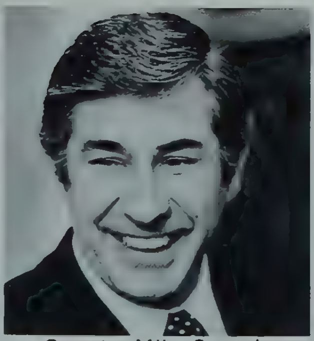
"Back in those days it was all the state could do to pay for its own operations, let alone provide assistance to local governments," Hensley recalls. "There were very few crumbs to pass around. There simply is no way Alaska could have survived without oil development."

United Bank Alaska is one of the shining examples of the place Alaska Natives are carving for themselves in the economy of a state vast in size but small in population.

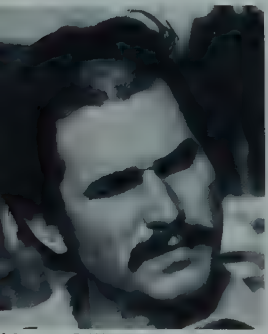
William J. Tobin, a veteran of 33 years as a reporter and editor, began covering Alaska for the Associated Press in 1956, three years before statehood. For the last 17 years he has been with The Anchorage Times, for 10 years as Managing Editor and for the last seven as Associate Editor and General Manager.



Senator Ted Stevens



Senator Mike Gravel



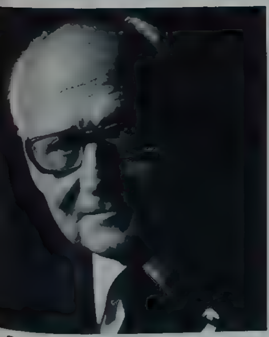
Mayor Bill Walker

Senator Russ Meekins Jr.

DON DORNAN

STEVE McCUTCHEON

JIM COCCIA



Dr. William R. Wood

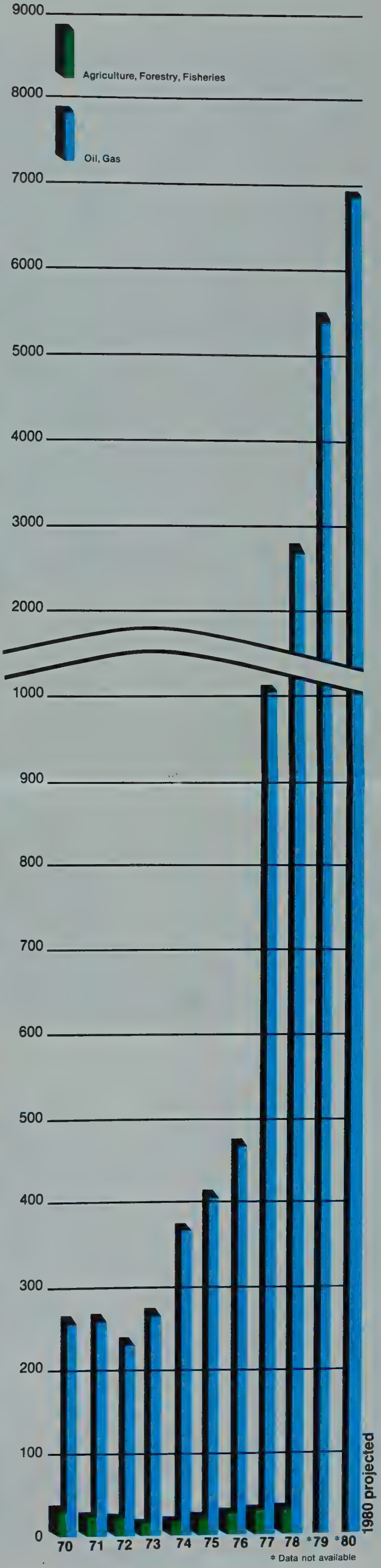
Willie Hensley

GROSS PRODUCT, ALASKA NATURAL RESOURCE PRODUCTION (1970-1980)

(Millions of Dollars)

Source: From Alaska Oil and Gas Conservation Commission Annual Statistical Reports.

Petroleum Production Forecast Quarterly Report—March 1980. Published by the Alaska Department of Revenue.



The $80 million bank, organized in December 1975 is entirely owned by seven regional Native corporations and one Native village corporation. Native corporations also are involved in major hotel operations, and real estate, fisheries, transportation, construction and a wide variety of enterprises which include joint ventures on many pipeline-related endeavors.

The NANA Regional Corp. is a good example. "We're into catering, drilling and oil field security, and we're providing room and board at Deadhorse on the North Slope," Hensley says. The corporation also is investing $30 million in two drilling rigs which are being built in Anchorage by Native craftsmen.

Taxes

"To picture how big all of this really is to the state," says Russ Meekins, "you need only consider that all the corporations in Alaska—apart from the petroleum industry—paid corporation taxes last year of only $28 million. Individual income taxes totaled $120 million. Yet we've run up a state budget of $1.2 billion. You know where the rest of the money came from."

Most of it, of course, came from oil; in the form of royalty payments, severance taxes and one of the nation's most singular forms of taxation against one industry, a property tax levied only on petroleum exploration, production and transportation facilities. Last year's payments to the state and local governments on the trans Alaska pipeline alone amounted to $160 million—the highest property taxes ever paid by any taxpayer in any state.

"Look around," says Meekins. "Everything you see we can attribute to the pipeline. The schools we have. The streets that are paved. It's incredible. We're living off that thing."

Future

And there is more to come, more opportunities to be realized.

"Just think what's ahead," Mayor Wood of Fairbanks says. "The Beaufort Sea. The Kuparuk fields. Water injection facilities. Collecting lines. A dozen more projects. They'll all cost more than the whole damn pipeline did to begin with."

That pipeline now flows with 1.5 million barrels of oil a day, matching the present production rate of the Prudhoe oil field. Its design capacity, with the addition of pumps and pump stations, would permit an increase to 2 million barrels a day in the event of the discovery of additional crude oil reserves.

Alaska and the nation have reason to hope that level will be reached sooner, rather than later.

Pipeline Meeting Environmental Tests

by Wallace H. Noerenberg

The trans Alaska oil pipeline was a key national target at the onset of "the environmental age". Some twenty major environmental groups were active on this in Washington, D.C., in the late 1960s and early 1970s with most seeking to dissuade the federal government from permitting the project.

It was strongly argued then that environmental degradation of the "fragile tundra" would be massive, and that fish and wildlife in a significant portion of Alaska would be destroyed or adversely affected. In retrospect, it now seems strange that one of the most persistent anti-pipeline arguments was that the United States had no particular need for the Prudhoe Bay oil, especially in view of the unavoidable environmental and fish and wildlife degradation which would ensue.

Now, over five years after initial construction and three years after pipeline operations began, it is the consensus of a broad array of state, federal, university and industry personnel who observed the project from its inception that practically none of the adverse predicitions of serious damage came true.

Despite the enormous, record setting size of the construction job, these people are hard put to recall serious problems that occurred. The few problems that did develop during and after construction were mostly related to fish migration barriers on small streams. These were almost all corrected within a year of discovery.

Most observers now feel that a valid assessment of effect of the pipeline will require a much longer period of operation. Clearly, this opinion also says, in effect, that if serious impacts are occurring, they are extremely difficult to observe or assess.

Integrity of the completed pipeline during operations is one measure of the quality of preliminary research and pipeline design and construction. During the three years of operations, only four significant incidents of losses of oil have occurred from the pipeline itself. Two other incidents involved accidents at Pump Station 8.

One instance was related to sabotage, one was a mechanical accident by earth-filling equipment, and the other two were related to uneven settling or melting of supporting soils, which caused severe stress on the pipe, and, eventually, small cracks allowed oil to escape. Considering the enormous possibilities for problems in an 800-mile pipeline, half of which is in permafrost regions, the limited number of oil spill accidents has been remarkable.

The Atigun Pass spill of June, 1979, was the most serious accident and investigations are still underway as to damage caused to the environment, fish and wildlife. This was the only case where significant quantities of oil entered stream systems.

Caribou graze near equipment at Prudhoe Bay.

A gull and a shorebird near Pump Station 1.

A federal report on this spill at the extreme headwaters of the Atigun River indicates that company response in cleanup was good. While the federal team estimated that 5,267 barrels of oil spilled, a significant portion of this oil was prevented from entering the stream systems by the collection of oil in constructed sumps below the break. Adverse effects on fish and wildlife were not detectable even though some oil sheen was noted in the river system.

In each of the pipeline oil spills, berms or containment dikes were constructed to control oil flow over the ground. In one case, controlled on-site burning of oil was used to clean up the spill site; in other cases, successful revegetation techniques were applied after mechanical cleanup and removal of recoverable oil. The latter system appears far more satisfactory in minimizing spill damage.

Disturbance of big game populations by human activity within the pipeline corridor and by migratory barriers posed by the elevated pipeline sections were key concerns prior to construction. Closure of all hunting (and fishing) within five miles of the pipeline during construction removed one major, direct threat to the animals. North of the Yukon River, the hunting closure is still in effect. Heavy vehicle activity during construction caused some road-kill accidents. The minimum traffic of the operational period has reduced road-kill problems. The attraction and feeding of bears, foxes and wolves during construction proved a problem, despite extreme company avoidance efforts.

Potential migratory-barrier problems were met by a variety of means. Hundreds of 10-foot-plus underpasses were designed into

Wallace H. Noerenberg is a fishery biologist with 32 years experience in Alaska. He was Commissioner of the Alaska Fish and Game department from 1969 to 1972, and he worked as a consultant on fish and wildlife protection matters to Alyeska from 1973 to 1975.

A grizzly on the pipeline workpad near the Dall River.

NANCY SIMMERMAN

elevated sections for this purpose. Some 26 special short burials, called sag bends, were also placed in the line to assist animal passage. In one area, refrigerated sections were installed to avoid disturbance of caribou.

In the Copper River drainage, the relatively large Nelchina caribou herd was known to migrate twice annually across the pipeline corridor enroute to eastern wintering grounds and western calving and summering grounds. High value was attached to protection of this herd, in part because of heavy usage by Fairbanks and Anchorage sports hunters. The very expensive refrigerated buried sections of pipeline were installed specifically to insure safe passage of this herd; sag bends and underpasses were also designed into the elevated sections to assist migrations.

Sterling Eide, state game biologist, who has observed the Nelchina herd the past four years, reports caribou have exhibited no difficulty in traversing the pipeline. They are commonly observed passing under elevated sections of 6 to 8-foot heights, i.e., not necessarily seeking the special crossings built for them. Further, revegetated areas along the pipeline have tended to attract large numbers of feeding caribou during the wintertime. Eide also reports the pipeline has presented no problem to the large moose herd of the Copper Basin.

Incidentally, due to unidentified factors, the Nelchina herd suffered a drastic population reduction (60,000 to less than 10,000) between 1968 and 1973. During and since pipeline construction, this herd has increased significantly in abundance.

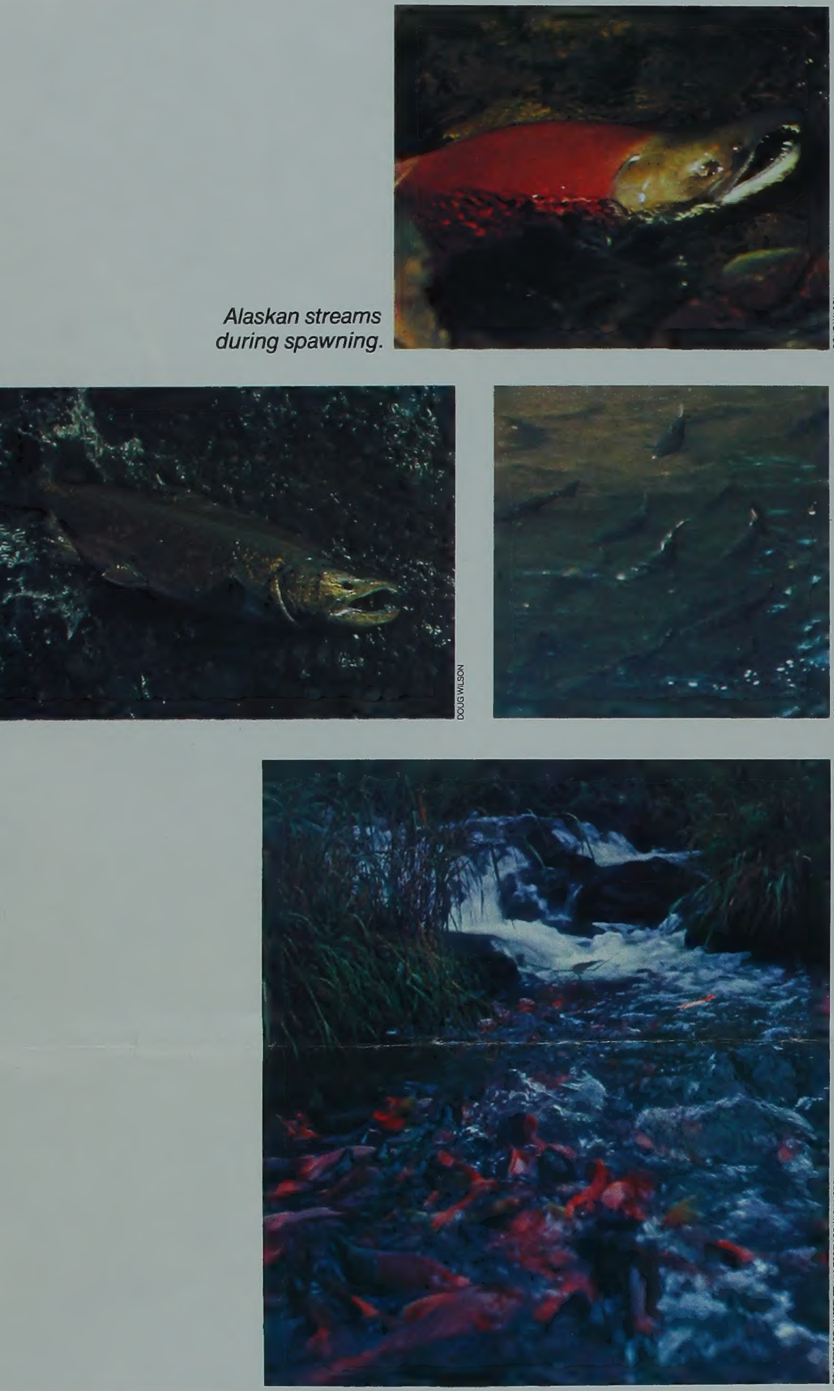
State biologist Roy Cameron of Fairbanks and his associates are unique in that they have research funds to study possible effects of the pipeline on caribou in the northern corridor. Despite tens of millions of dollars in the annual Fish and Game department budgets, it seems noteworthy that an insignificant amount is programmed for study of the effect of the pipeline on fish and game.

Cameron's published works on the small (5,000 to 6,000) Central Arctic caribou herd, which lives year-around in the vicinity of the Prudhoe Bay oil field, suggests avoidance of the elevated pipeline by cows with calves during summer and fall, while mature bulls and other portions of the herd seem unaffected.

Similar tendencies have been noted among sheep populations in the Brooks Range. Pregnant females have been noted to disappear from the corridor at lambing time, but other members of the sheep populations are often distributed remarkably close to or on the pipeline and haul road.

Most observers, including Dr. David Kline of the University of Alaska Wildlife department, feel it is much too early to understand the effects of the pipeline on big game, especially caribou. Response to highway traffic, and the increasing numbers of people who will gain access to the Arctic region via the highway, will probably be more important factors than physical presence of the pipeline structure.

Salmon hold a special place in the hierachy of Alaskan fishes, and, consequently, there was pre-construction concern for their well-being in the pipeline corridor. Principal interactions with salmon were in the Copper River tributaries, at the main Yukon River crossing, and, to a lesser extent, in the Lowe River, Tanana River and Koyukuk River tributaries. Actually, Arctic grayling and several whitefish species were the principal fish


Alaskan streams during spawning.

DOUG WILSON

DOUG WILSON

DOUG WILSON

FISH RESEARCH INSTITUTE UNIVERSITY OF WASHINGTON

South of the Brooks Range near the Arctic Circle.

occurring in the pipeline corridor.

According to a number of salmon biologists in both northern and southern sectors, neither pipeline construction nor subsequent operations has caused any known damage to the salmon populations. Construction was conducted in non-sensitive periods whenever possible. Some major streams were bridged by the pipeline, but the line was buried well under the streambed in most cases.

Federal stipulations anticipated construction of many spawning channels to replace lost natural salmon habitat. Actually, only one such channel was ever built. A spring creek tributary to the Lowe River was moved to a new channel to avoid some 4,000 feet of buried pipeline. In 1979, fairly heavy usage by pink, coho and chum salmon was observed by resident biologist Ken Roberson. He classifies the channel as a very successful development.

In the Salcha River south of Fairbanks, the largest count of king salmon observed in 20 years of surveying occurred in 1979. These fish were present in the river as juveniles during construction of the pipeline and evidently suffered little or no damage. Prior to construction, the Department of Fish and Game had attempted unsuccessfully to procure rerouting of the line to avoid this run of kings.

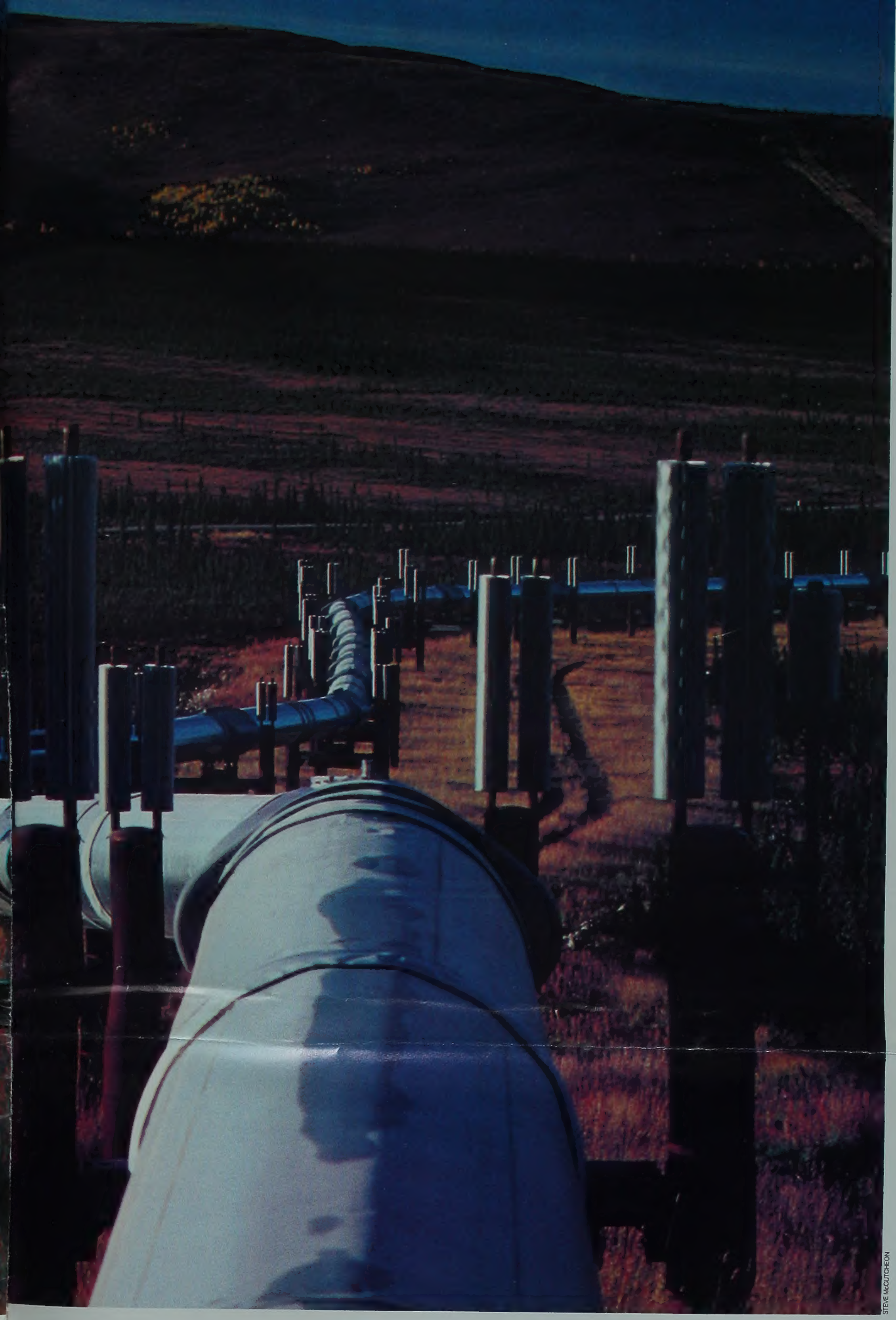
As noted, fish problems along the pipeline mostly involved grayling and whitefish, which migrate into a multitude of small creeks during spring breakup floods and must evacuate these streams before fall freezeup. Malfunction of culverts due to icing or flood flows is a common problem. A system called "low water crossings" was used extensively along the work pad to avoid culverts. At these crossings, large rubble was added to strengthen the bottoms and banks where the pad was crossed by the stream. This inhibited erosion of the stream and allowed vehicles to ford and water to move freely over the pad at all levels of flow. Problems involved construction errors in elevation of crossings, causing subsurface flow during low water and consequent fish migration blockage. These problems were infrequent and have been corrected as detected.

Since a large majority of the small streams crossed have intermittent flows, i.e. are dry and/or frozen during most of the winter, pipeline construction could be programmed during the dry periods without fear of doing any damage to fish populations. Where streams had to be excavated during flowing periods, some downstream siltation was inevitable. However, a system of fluming stream waters around the construction was commonly used.

Virtually all disturbed areas along the 800-mile pipeline corridor except roadbeds, were the target of a massive revegetation effort by Alyeska. The principal objective of the program was to control erosion, and thus to protect the pipeline.

Extensive research was expended in test-plot experimentation with various seed mixtures. Soil analysis indicated necessary fertilization mixtures required. Some 3,000 vegetation units along the line were dealt with, generally with high success. Four different seed mixtures (7 to 9 varieties of grasses in each) were developed for four environmental zones found along the line.

Dr. William Mitchell, University of Alaska Extension Service in Palmer, has worked with Alyeska since 1969 to plan and improve the revegetation program. He was involved in research on the numerous test plots along the line and has also developed three new grass varieties using Alaskan Arctic source material at the Palmer experiment station. Sufficient supplies of these new varieties were not available in time to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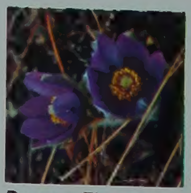
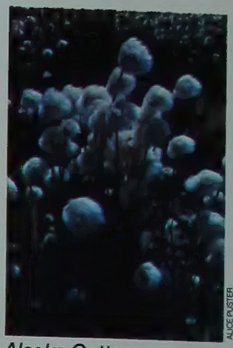

Pasque Flower

KEN ROBERSON


Alaska Cotton

ALICE PUSTER

Wild Rose

ALINE STRUTZ

Douglasia

ALINE STI

Construction area reseeded.

STEVE McCUTCHEON

use on the initial pipeline corridor revegetation, and, therefore, commercial supplies from northern states were used.

It is anticipated that native grasses will gradually invade the disturbed areas, and that the imported grass varieties will survive from only five to seven years. Also, it is not anticipated further fertilization will be necessary in most of the revegetation units.

One phase of the revegetation program which failed was an attempt to plant willow seedlings in certain areas of the North Slope for use by big game, primarily moose. Original plantings died and research on new techniques for another trial is underway at the University in Fairbanks. Another key pre-permit issue relating to the pipeline project was the environmental effect of the tanker terminal operation. Air quality in the small inner basin of Port Valdez and water discharge quality at the ballast water treatment plant were principal concerns.

Air emission levels have remained well below the permissible standards set by the government. The tankers, and not terminal facilities, are the principal pollution (sulfur dioxide) source.

The ballast water treatment plant was allowed by permit to release water with up to 8-parts per million oil content. This water is released at great depth in the harbor and under conditions encouraging great and rapid dilution of the effluents. The monthly averages for samples of effluent since the start of operations in August, 1977, show a consistent pattern well below permissible levels. The original oil/water separation system using air flow and alum flocculation was replaced by a better system in late 1978. Since that time, oil in effluent water has averaged only 3 parts per million.

The Institute of Marine Science of the University of Alaska has been involved in Port Valdez oceanographic studies for Alyeska both before and after terminal construction. Rapid flushing of waters of this semi-restricted basin into Prince William Sound has been noted, thus avoiding accumulations of crude oil residues within Port Valdez.

At this stage of study, no evidence has been uncovered that the ballast water discharges are affecting the water quality or biota of Port Valdez. However, the University cautions that too short a time has elapsed since operations and hydrocarbon research began to expect dramatic effects on marine populations.

Tentatively, it can be said that the trans Alaska oil pipeline has had much less adverse impact on the environment than even the most optimistic forecasts of the preconstruction period. This has to be credited to the extensive planning efforts of the company prior to construction and to adherence to those plans by the construction crews and the governmental field inspectors. Considerable time will be required to fully assess the long-term impact of this development.

Alyeska Reports

September 1980 Vol. 4

Alyeska Pipeline Service Company
1835 South Bragaw
Anchorage, AK 99512

F.G. Turpin, *President*

Alyeska Pipeline Service Company committed itself to keeping the public informed about its progress in the design, construction and operation of the trans Alaska pipeline.

To help meet this commitment, Alyeska has published this special commemorative issue of *Alyeska Reports,* a magazine published quarterly during the three years of pipeline construction.

Alyeska Reports is published by the Public Affairs Department, John F. Ratterman, Manager.

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Alyeska pipeline
SERVICE COMPANY

The last regular quarterly issue of "Alyeska Reports" was published in October, 1977, shortly after the completion of construction and beginning of operation of the trans Alaska pipeline. This special issue is our report on the events which have transpired since then, in the first three years of operation of the line.

You have read in this issue about some of the technical and environmental challenges which faced the designers, and later the builders, of the pipeline, when some believed the challenges presented by Arctic cold and intimidating terrain and distance could not be successfully met—and how subsequent events have proven they *were* met.

You have also read here about our record in the three years since the beginning of operation, August 1, 1977. It is an excellent record, but one not entirely unblemished. In these pages are recorded both the milestones of this period, our successes, of which we are very proud, and the disappointments. But even in our few instances of adversity I have been proud of our response to the difficulties with which we suddenly were confronted. We proved we knew our jobs, and could do them well, in response to emergency as well as in daily routine. In this sense we have continued the tradition established by the very earliest conceptual planners of the pipeline, and enhanced by their successors, the builders of the line, of responding to challenge: if it had to be done, they did it, despite the odds against success and the doomsayers' predictions of failure.

Today's operators are similarly meeting the challenge presented to them: safe and efficient operation of the trans Alaska pipeline.

It is a big and important job. I am proud of the way we are doing it.

F. G. Turpin
President

Three years of operation have confirmed the design of the 800-mile trans Alaska pipeline. The unique above-ground design, used on much of the North Slope and elsewhere, has proven particularly effective in eliminating problems with permafrost.

Fears that the pipeline might interrupt migration of Alaska's caribou herds, and the movements of other wild animals, may have been greatly overemphasized. Although much must yet be learned, biologists thus far have detected little evidence of problems posed by the pipeline for Alaska's wildlife.

Special training programs, provided by Alyeska Pipeline Service Company, encourage pipeline personnel to expand their skills while on the job. Pump station crews work 12 hours a day for one week and then get a week off.

More than 1.5 million barrels of oil now are being pumped through the pipeline each day to the Valdez Terminal and tankers, matching the production rate of oil fields at Prudhoe Bay.

The economic growth of Valdez, southern terminus of the pipeline, is an indication of the impact of the pipeline on several aspects of Alaskan life. The port city, now four times larger than it was before pipeline construction began, expects to continue its growth.